EFFECTS OF COMMERCIALLY-AVAILABLE TENNIS SHOES ON MOTOR PERFORMANCE

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INTRODUCTION: The effects of different footwear design features on motor performance has been studied in the cases of footwear with studs (Bauer, 1970) and basketball shoes (Brizuela *et al*., 1997; Robinson *et al*., 1986; Valiant & Himmelsbach, 1996). The results obtained in these studies (Table 1) indicate that the different elements of design in sports footwear can decrease motor performance by 1%-9%, depending on the type of displacement analyzed.

Table 1: Decrease of motor performance according to (a) Bauer (1970), (b) Robinson et al., (1986), (c) Brizuela et al., (1997), (d) Valiant & Himmelsbach (1996).

Type of displacement	Decrease in motor performance (% on control model)
Running forwards	1.12 (a)
Agility running	1.9 (b); 1 (c); 5.5 (d); 9 (d)
Vertical jump	3 (c)

However, there are no studies which quantify the effects of different design elements of tennis shoes or of different technical tennis shoes models on motor performance in the most important and frequent types of displacement which occur during a tennis match.
The objective of the present work was to determine whether the different models of technical tennis shoes available on the market affected motor performance in a running circuit with changes of direction, turns, braking and starting. In addition, we tried to determine whether the subjects noticed such differences.

MATERIALS AND METHODS: A footwear sample was selected consisting of the 10 best sport shoe models purchasable in Valencia, based on a previous market survey. The test subjects were 6 male tennis players, free from pathologies of the locomotor system.
As a field test, a circuit was used consisting of several turns of 45º and 90º, forward and backward running, braking and starting (Figure 1). To record times, a chronometry system was used with two photocells, one at the start and another at the finish, connected as triggers of starting and stopping to a 0.001 second-precision digital chronometer.

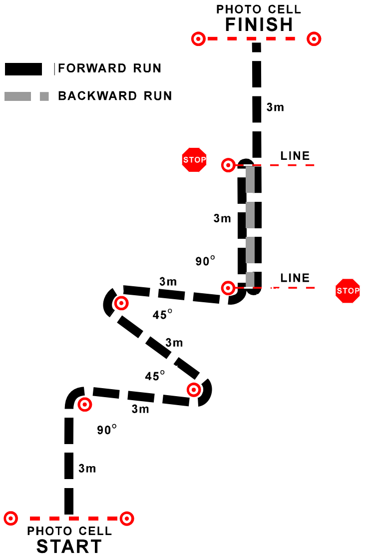

Figure 1. Test circuit.

In the tests, each subject wore each model in the sample twice, in a previously randomized order. To prevent the results from being affected by fatigue, each repetition was followed by a rest period lasting 2 minutes. After testing each model, the subject scored the functional adequacy of the model for the task performed, according to a Likert-type scale of five levels (Table 1), without knowing the time taken to perform the task.

Table 1: Likert scoring scale used to obtain the subjective variable of performance.

Score	Functional adequacy of footwear for task
1	Very poorly adequate
2	Poorly adequate
3	Adequate enough
4	Quite adequate
5	Very adequate

An analysis of variance (ANOVA) was done with the times recorded, each model and subject serving as factors, using Statgraphics-plus software. The significance level was set at 0.05, and significant differences were evaluated by means of a *post hoc* analysis using LSD methodology. In the same way, a non-parametric analysis of variance (Kruskal-Wallis test) was done with the ratings given to the models by the subjects. Finally, with the results of both variables, a non-parametric correlation analysis (Spearman) was done.

RESULTS: The results obtained showed statistically significant differences (p< 0.0001) in the mean times recorded, grouping the models in the four groups shown in Table 2.

Table 2: Time (s) for each model in the sample and groups formed.

Model	Time (mean ± standard error)	Groups			
M1	8.055 ± 0.33	1			
M7	8.114 ± 0.33	1	2		
M9	8.123 ± 0.33	1	2		
M4	8.134 ± 0.33	1	2	3	
M5	8.171 ± 0.33		2	3	
M6	8.188 ± 0.33		2	3	
M10	8.203 ± 0.33		2	3	
M2	8.221 ± 0.33			3	
M8	8.432 ± 0.33				4
M3	8.483 ± 0.33				4

In the case of the subjective variable, the results also showed statistically significant differences (p = 0.0001) among the 10 models in the footwear sample analyzed. Table 3 presents the results obtained ordered from higher (better evaluated) to lower (worse evaluated) score.

Table 3: Score given to each model in the sample.

Model	**Score (mean ± standard error)**
M10	4.2 ± 0.9
M6	4.0 ± 0.0
M4	3.8 ± 0.9
M9	3.7 ± 0.5
M5	3.5 ± 1.0
M1	3.2 ± 0.4
M7	3.2 ± 0.7
M2	2.8 ± 0.9
M3	2.2 ± 0.4
M8	1.5 ± 0.5

Both results showed a statistically significant correlation (r = 0.6445, p = 0.007).

DISCUSSION: The results obtained for the variable "time taken" show differences in motor performance of 5% between the best (M1) and the worst (M3) models. This difference is within the range indicated by studies which have analyzed the effects of footwear on motor performance, as summarized in Table 1.

However, the correlation between the times taken to perform the task and the subjective evaluations by the subjects supports the use of subjective tests in the biomechanical study of sports footwear, not only in this case, but also in the study of any type of footwear.

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